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1. REPORT DATE (DD-MM-YYYY)		2. REPORT TYPE Interim Research Performance Report (Monthly)		3. DATES COVERED (From - To) June 1 - June 30, 2013	
4. TITLE AND SUBTITLE Expeditionary Light Armor Seeding Development				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER N00014-13-1-0219	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Shridhar Yarlagadda, Bazle Haque				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) UNIVERSITY OF DELAWARE OFFICE OF THE VICE PROVOST FOR RESEARCH 220 HULLIHEN HALL NEWARK, DE 19716-0099				8. PERFORMING ORGANIZATION REPORT NUMBER MONTHLY-3	
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12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; distribution is Unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Previous 2D AutoDyn mesh sensitivity analyses of cylinder impact on ceramic determined the 0.20-mm mesh size provides a fracture pattern that may be considered acceptable Previous mesh sensitivity analyses used a constant erosion strain value of 1.0 for the projectile and 2.0 for the target Using the accepted 0.20-mm mesh size, analysis has been conducted to determine the effect of erosion strain on target fracture patterns and projectile kinetic energies Erosion strain sensitivity analysis is performed using three different geometric strain values for both the target and projectile, totaling 9 different models We will explore the effect of plastic strain erosion in further AutoDyn analyses					
15. SUBJECT TERMS 2D AutoDyn modeling, cylinder impact, conico-cylinder impact, fracture pattern, mesh sensitivity, erosion strain					
16. SECURITY CLASSIFICATION OF: UU			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 18	19a. NAME OF RESPONSIBLE PERSON Shridhar Yarlagadda
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (include area code) 302-831-4941

20130725015



MONTHLY REPORT
JUNE 2013

**MODELING AND SIMULATION OF CERAMIC
ARRAYS TO IMPROVE BALLAISTIC
PERFORMANCE**

Monthly Report for June 2013



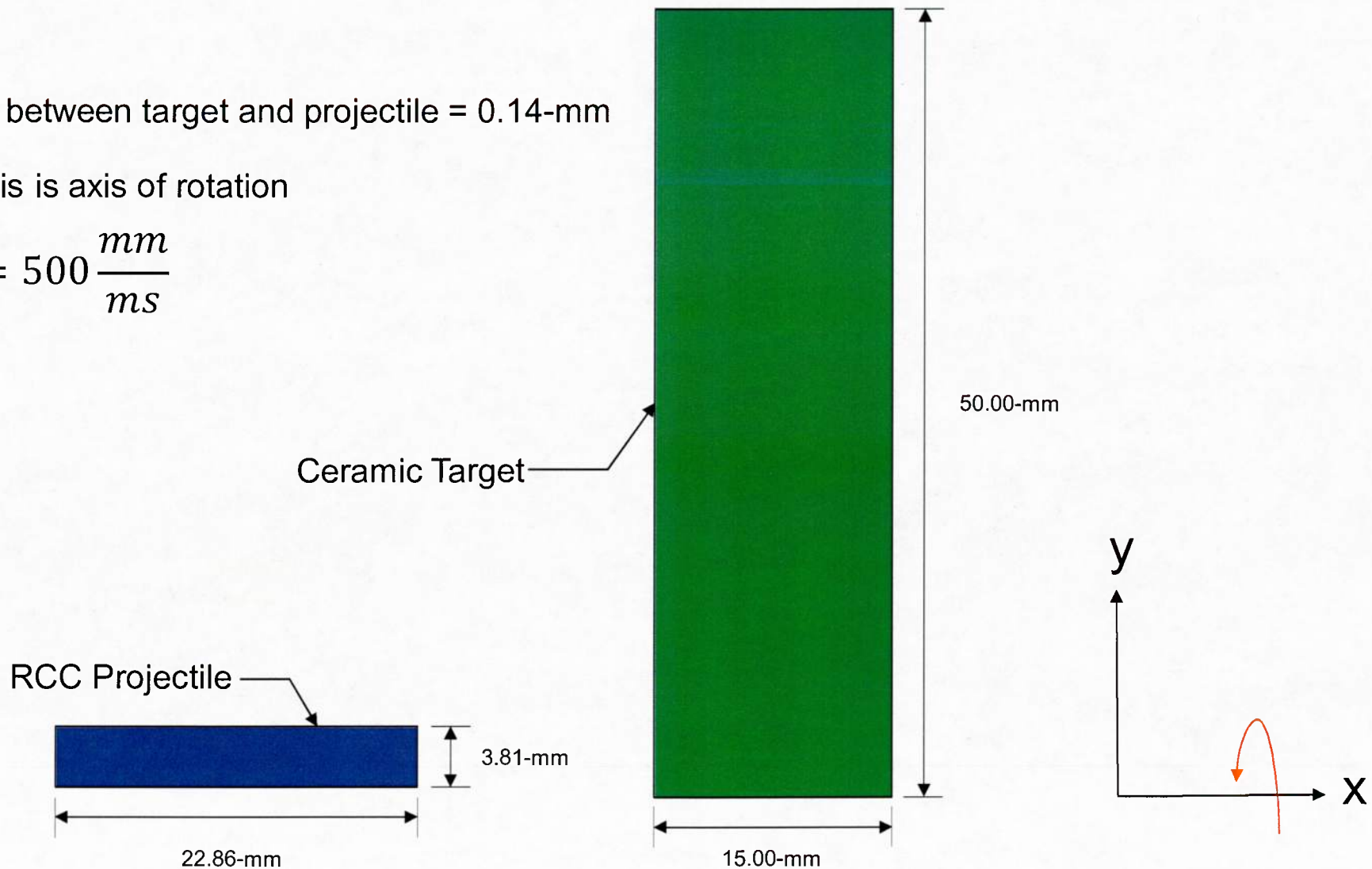
- ☐ Previous 2D AutoDyn mesh sensitivity analyses of cylinder impact on ceramic determined the 0.20-mm mesh size provides a fracture pattern that may be considered acceptable
- ☐ Previous mesh sensitivity analyses used a constant erosion strain value of 1.0 for the projectile and 2.0 for the target
- ☐ Using the accepted 0.20-mm mesh size, analysis has been conducted to determine the effect of erosion strain on target fracture patterns and projectile kinetic energies
- ☐ Erosion strain sensitivity analysis is performed using three different geometric strain values for both the target and projectile, totaling 9 different models
- ☐ We will explore the effect of plastic strain erosion in further AutoDyn analyses

Axi-Symmetric Model Geometry

Gap between target and projectile = 0.14-mm

X-axis is axis of rotation

$$V_P = 500 \frac{mm}{ms}$$



Erosion Parameters Examined



NOMENCLATURE

GS- Geometric Strain Erosion

PS – Plastic Strain Erosion

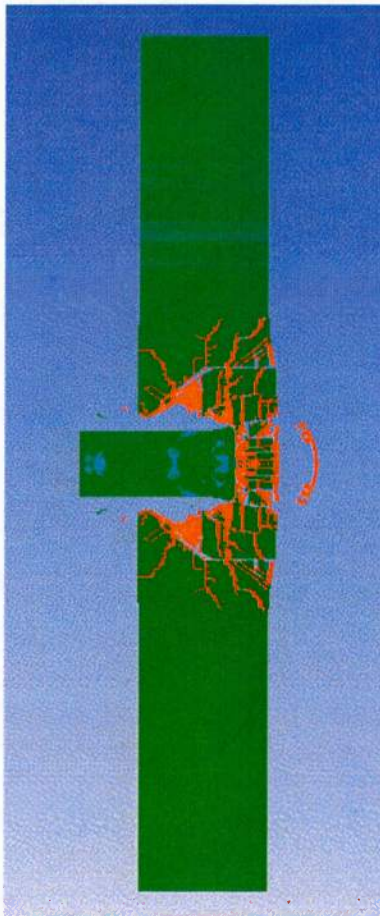
T – Target

P – Projectile

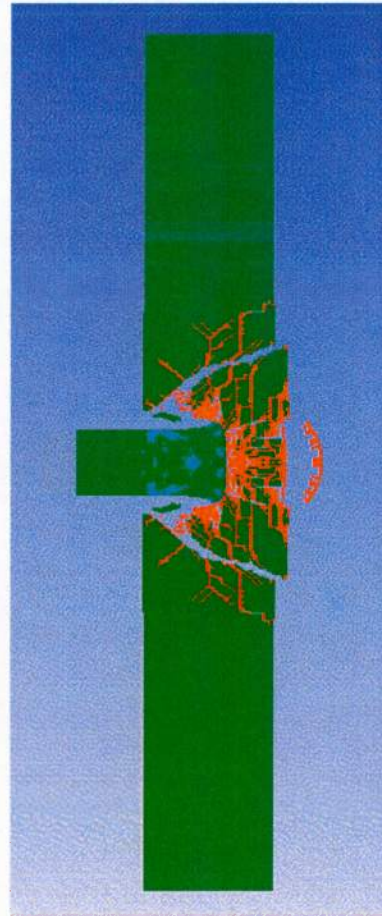
GS	P-0.5	P-1.0	P-2.0
T-0.5	X	X	X
T-1.0	X	X	X
T-2.0	X	X	X
PS	P-0.5	P-1.0	P-2.0
T-0.5			
T-1.0		X	
T-2.0			X

This case is represented by PS-P-1-T-1

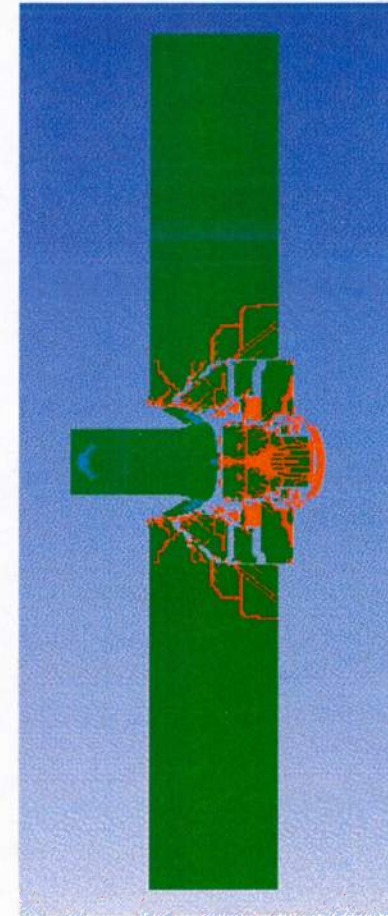
Fracture Pattern T-0.5, $t = 0.040$ -ms



GS-P-0.5-T-0.5



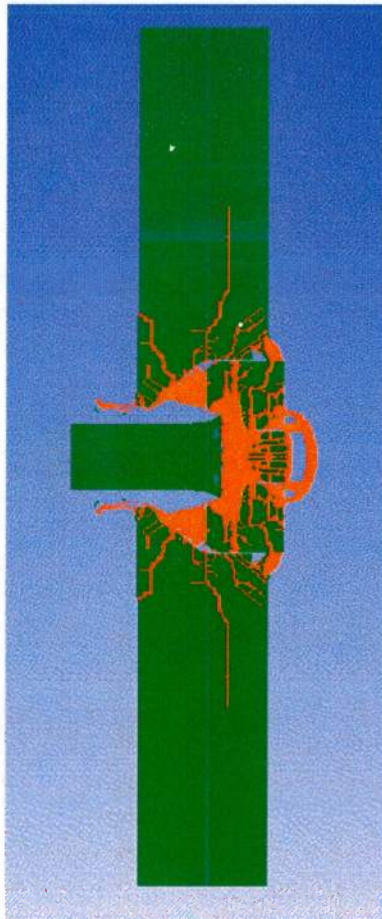
GS-P-1-T-0.5



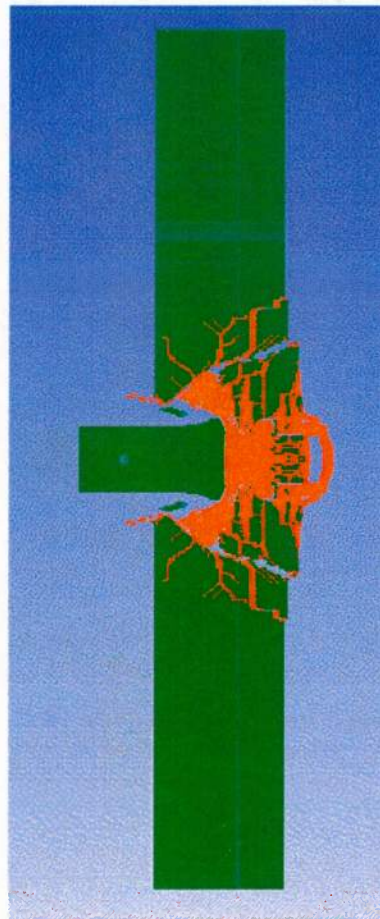
GS-P-2-T-0.5

Conclusion: P-2 fracture does not agree with other two cases

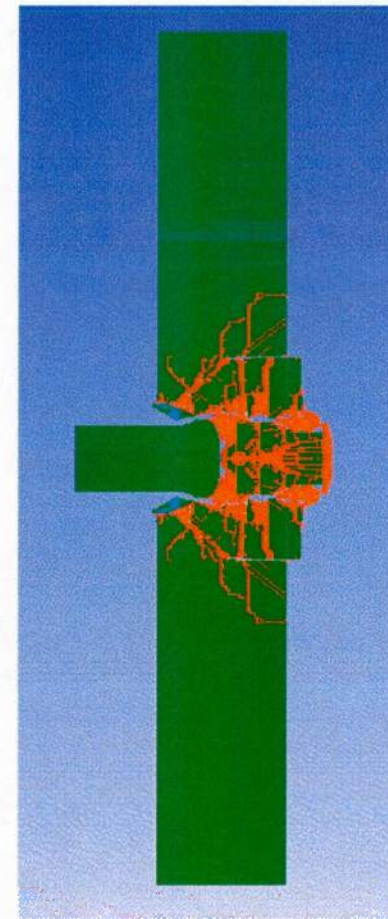
Fracture Pattern T-1, $t = 0.040$ -ms



GS-P-0.5-T-1



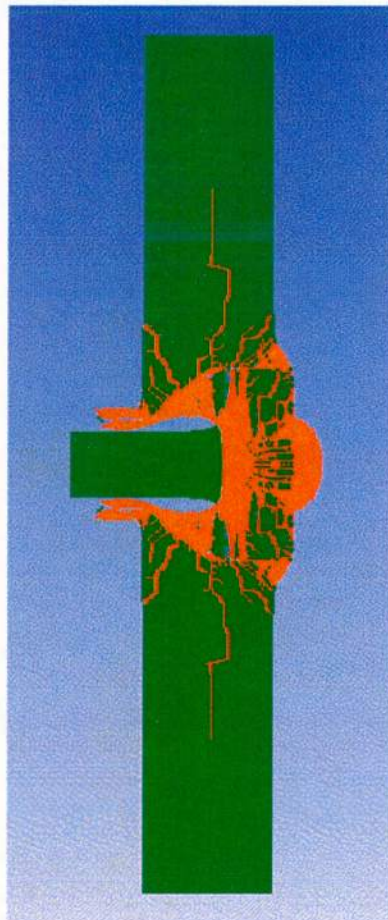
GS-P-1-T-1



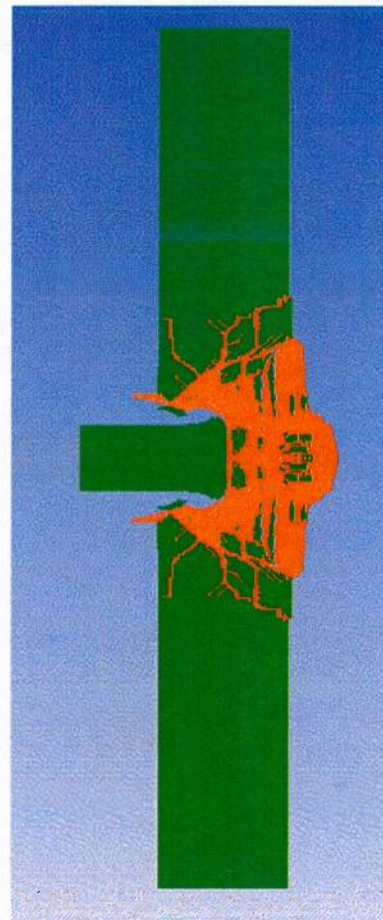
GS-P-2-T-1

Conclusion: Target has similar fracture for all cases

Fracture Pattern T-2, $t = 0.040\text{-ms}$



GS-P-0.5-T-2



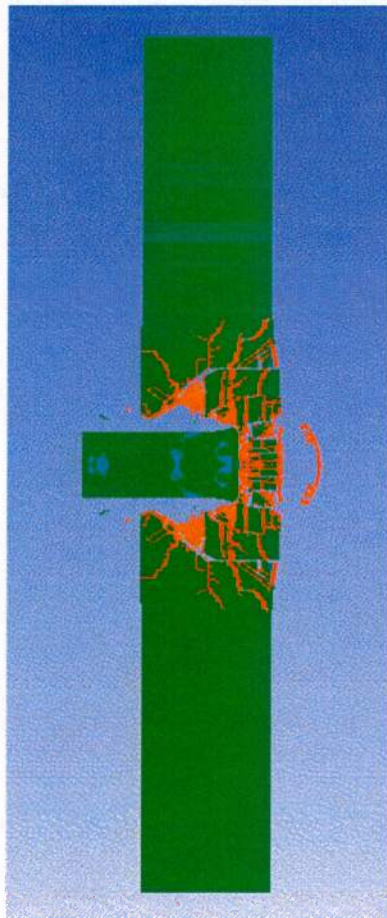
GS-P-1-T-2



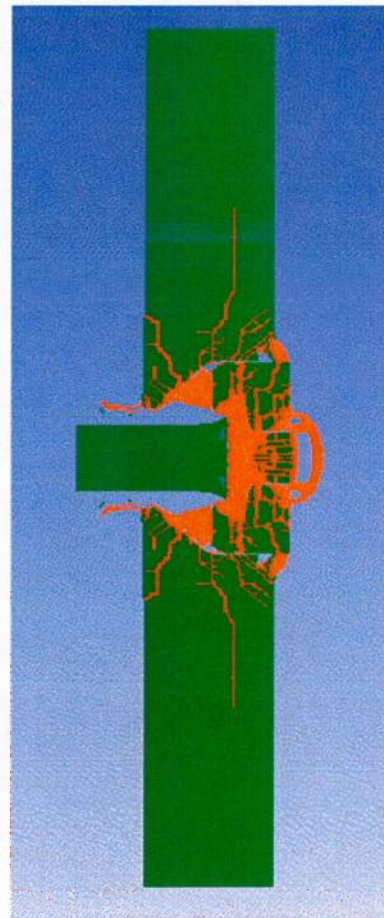
GS-P-2-T-2

Conclusion: Target has similar fracture for all cases

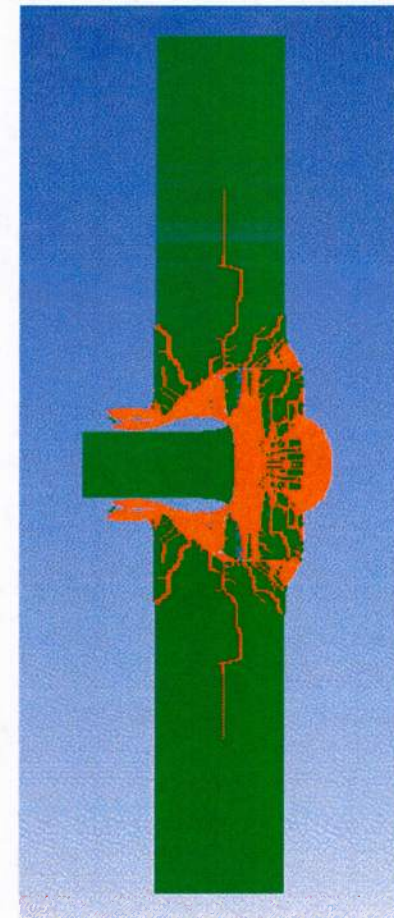
Fracture Pattern P-0.5, $t = 0.040$ -ms



GS-P-0.5-T-0.5



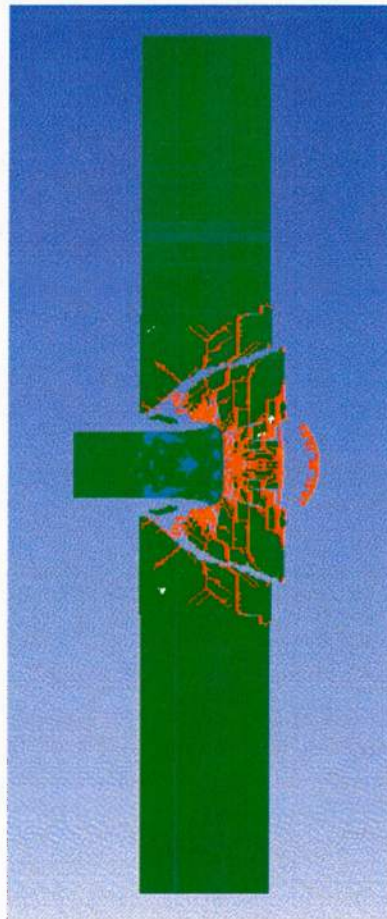
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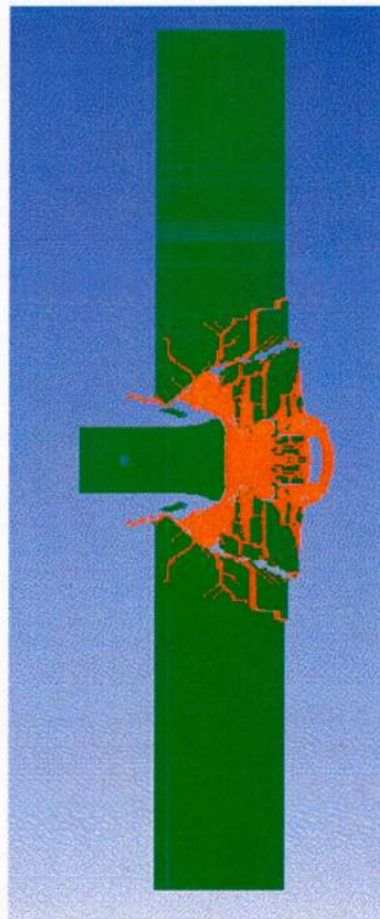
GS-P-0.5-T-2

Conclusion: T-0.5 fracture does not agree with other two cases

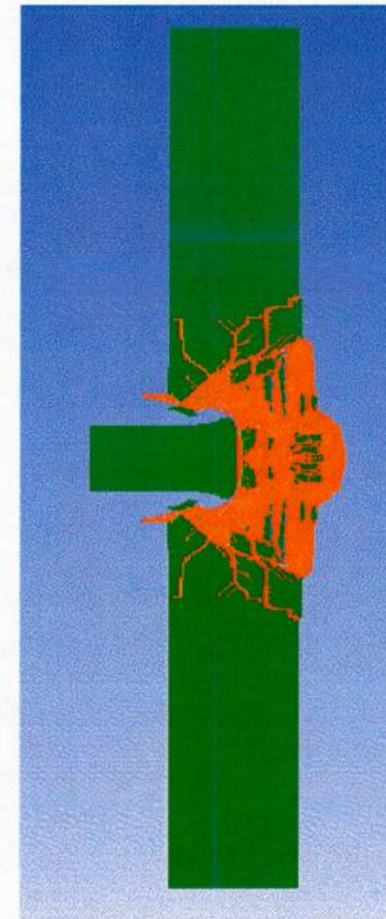
Fracture Pattern P-1, $t = 0.040$ -ms



GS-P-1-T-0.5



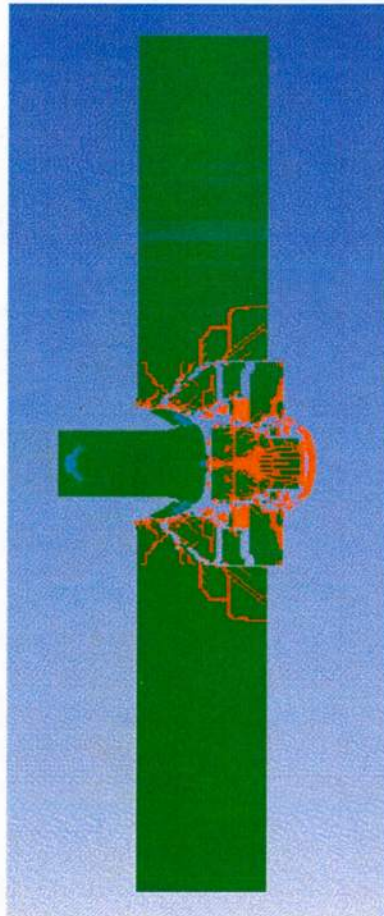
GS-P-1-T-1



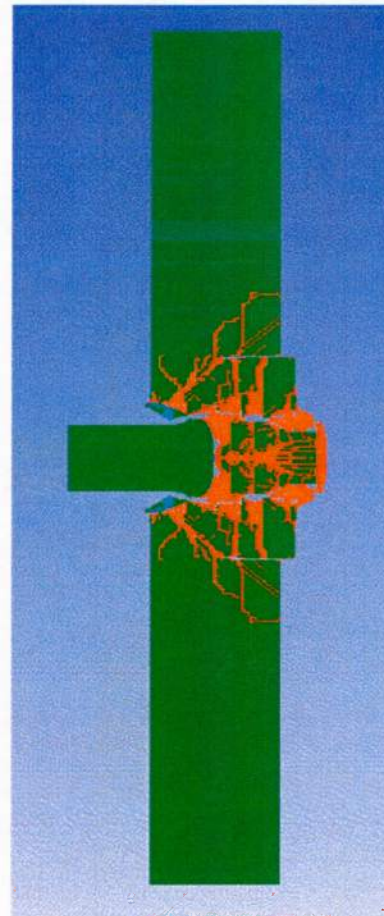
GS-P-1-T-2

Conclusion: T-0.5 fracture does not agree with other two cases

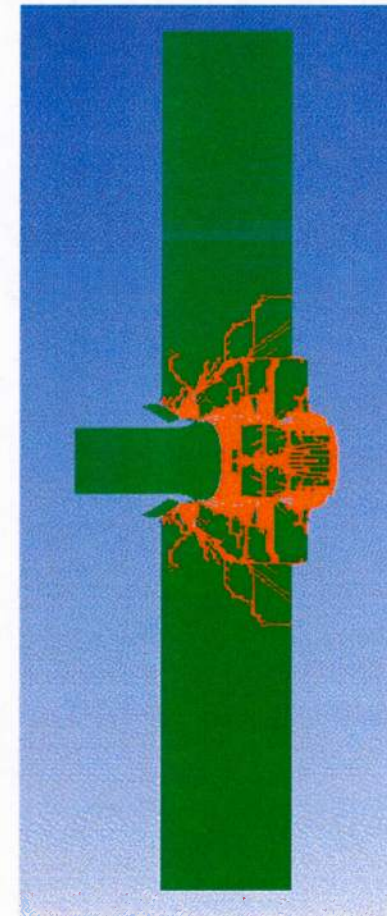
Fracture Pattern P-2, $t = 0.040$ -ms



GS-P-2-T-0.5



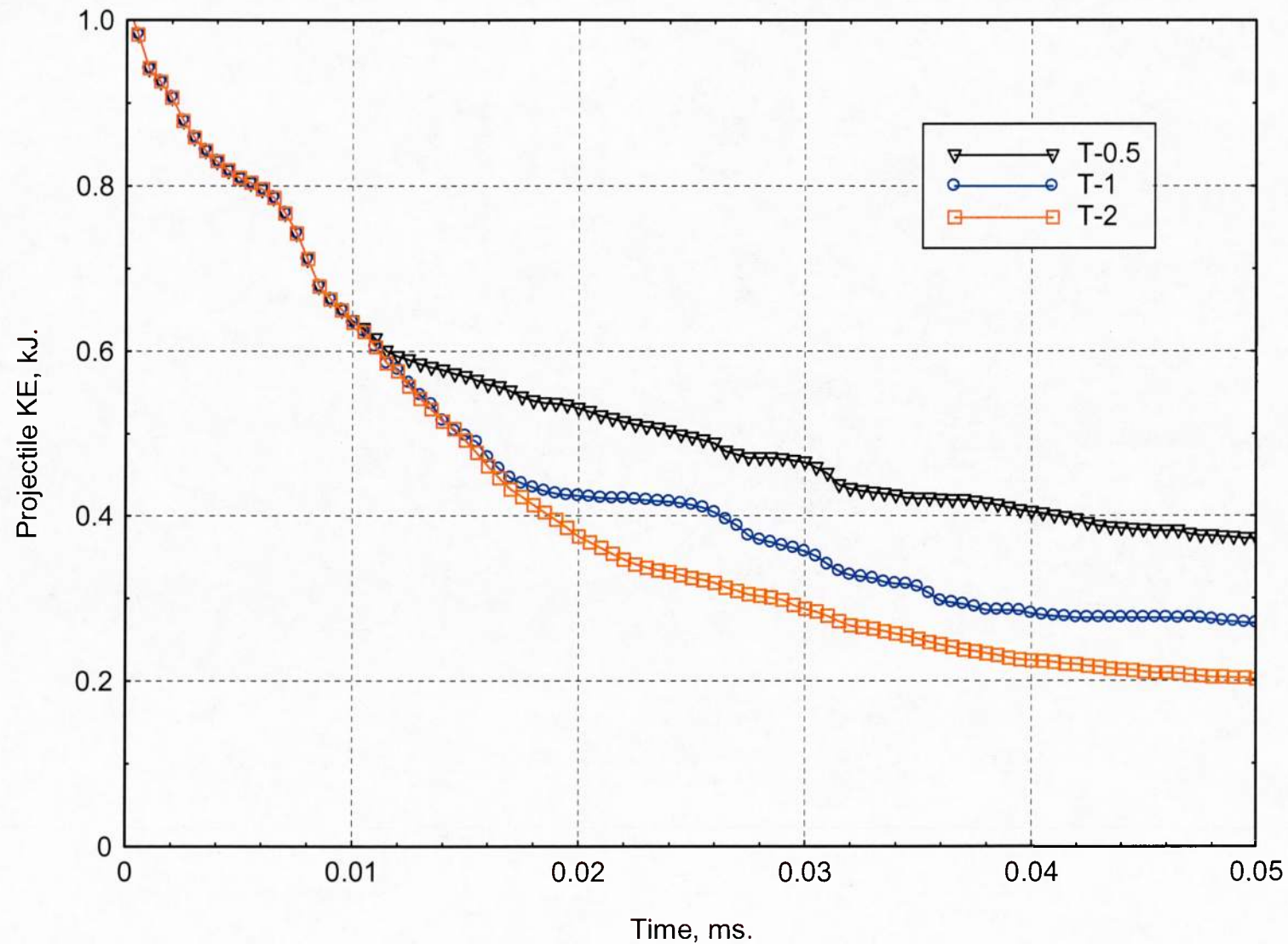
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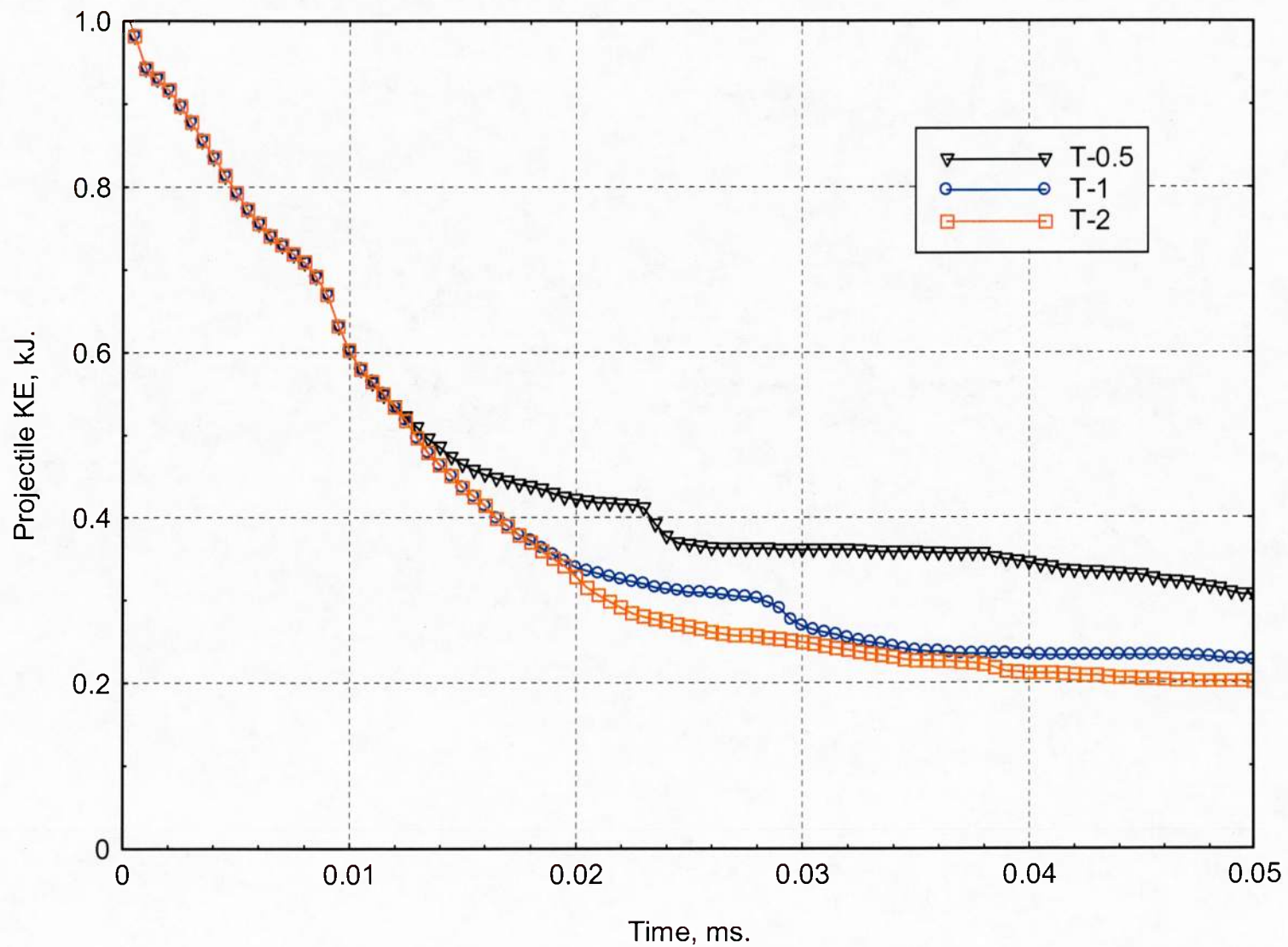
GS-P-2-T-2

Conclusion: T-0.5 fracture does not agree with other two cases

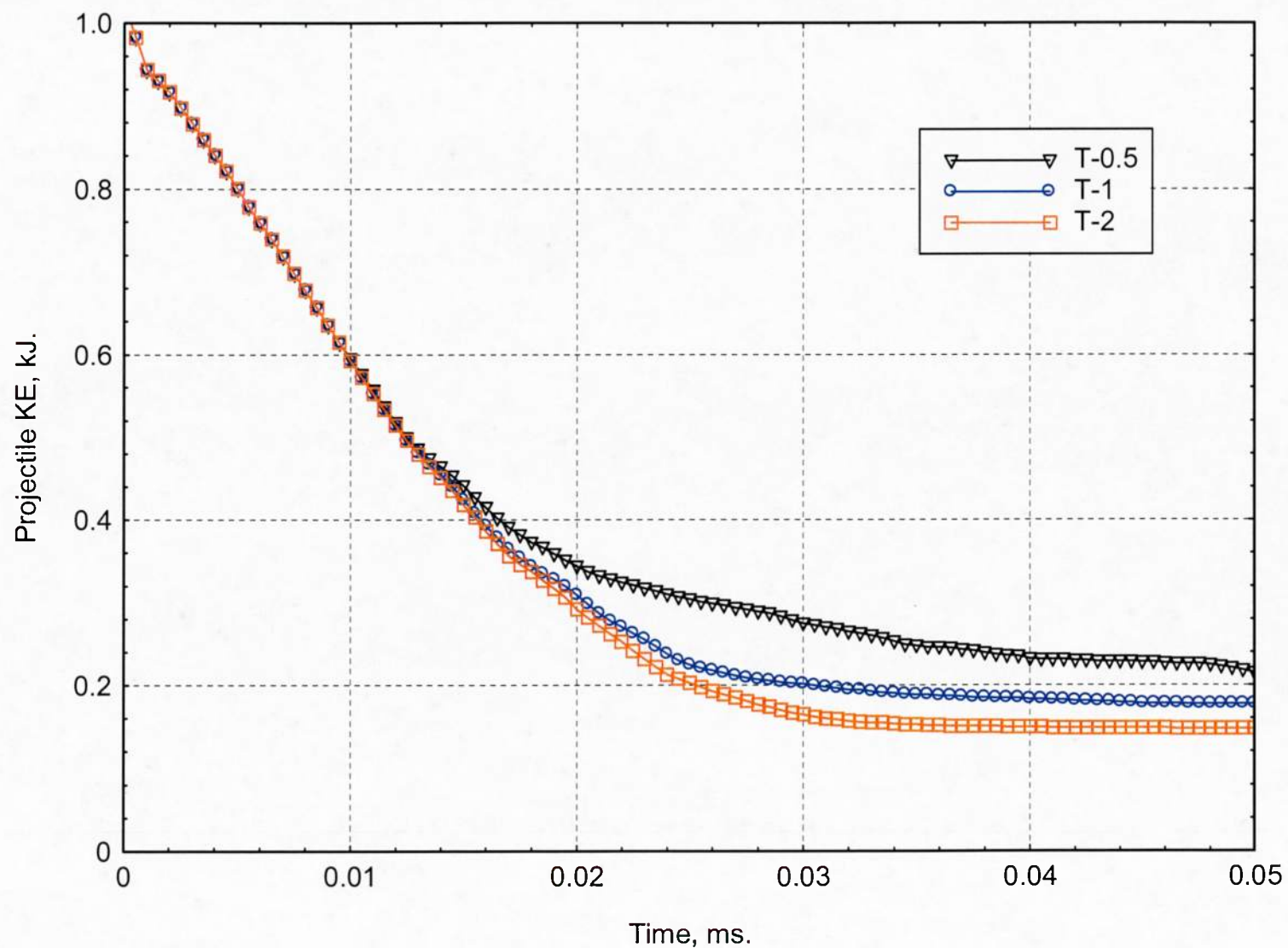
Energy Profile: P-0.5



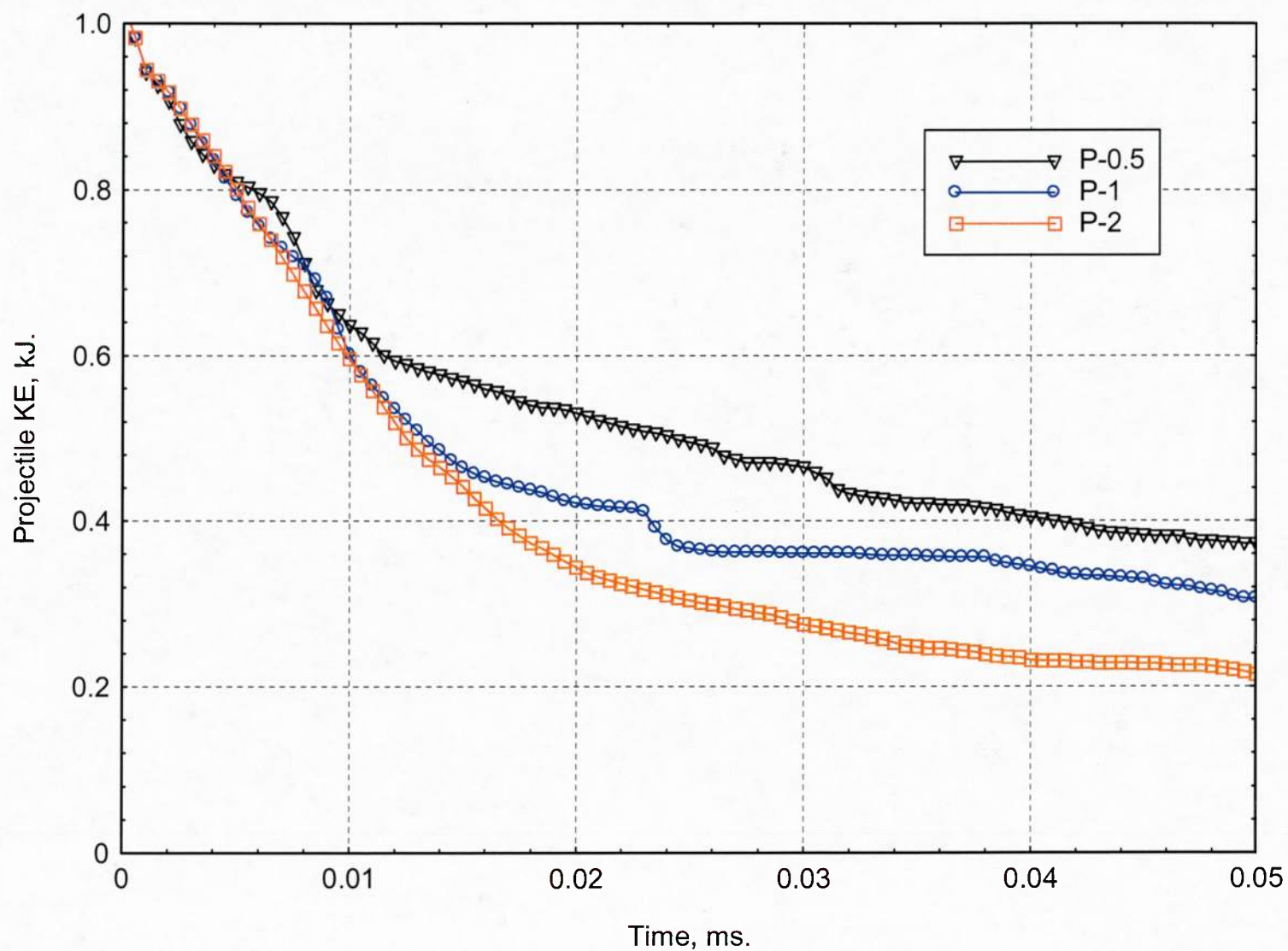
Energy Profile: P-1



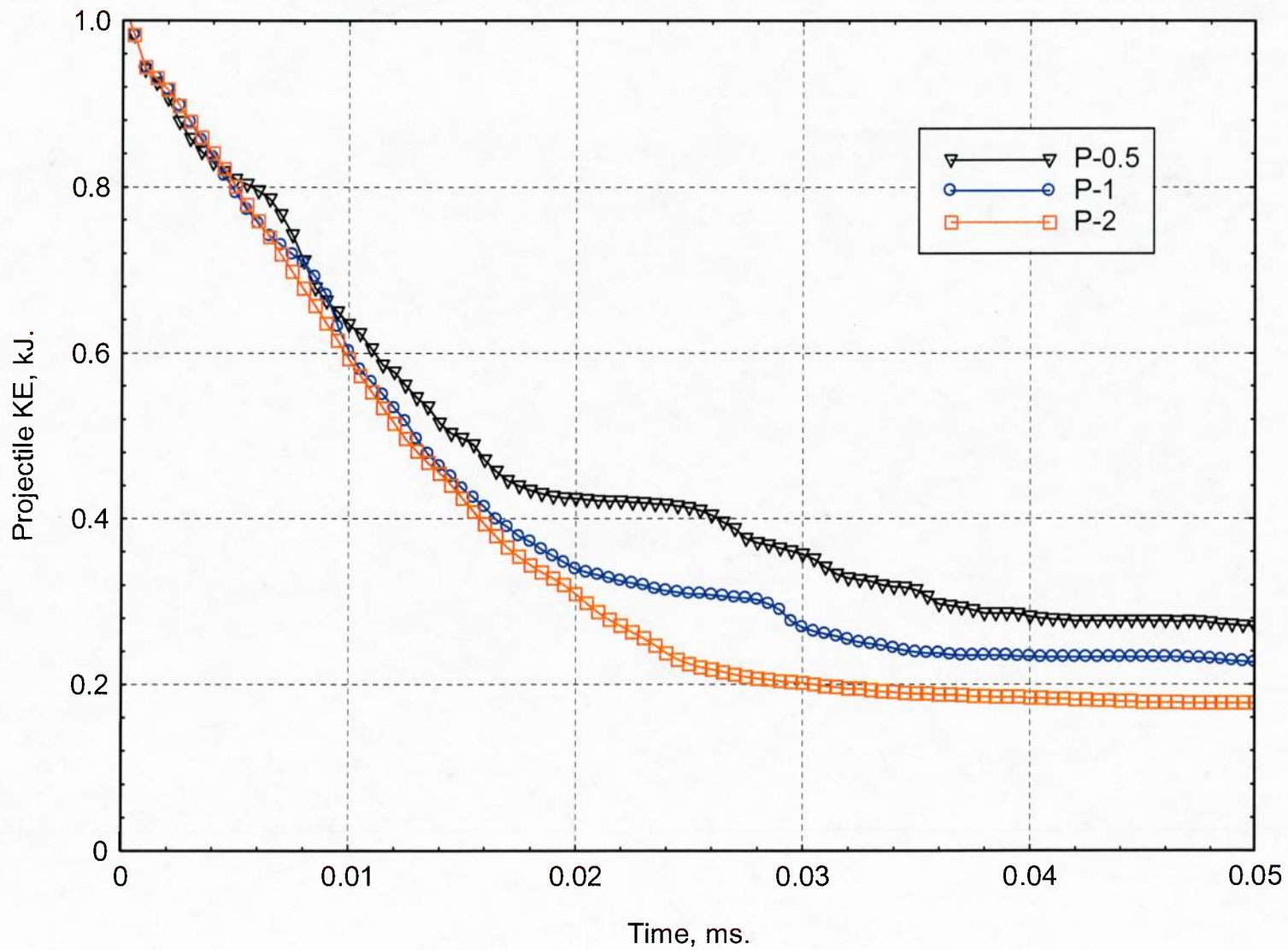
Energy Profile: P-2



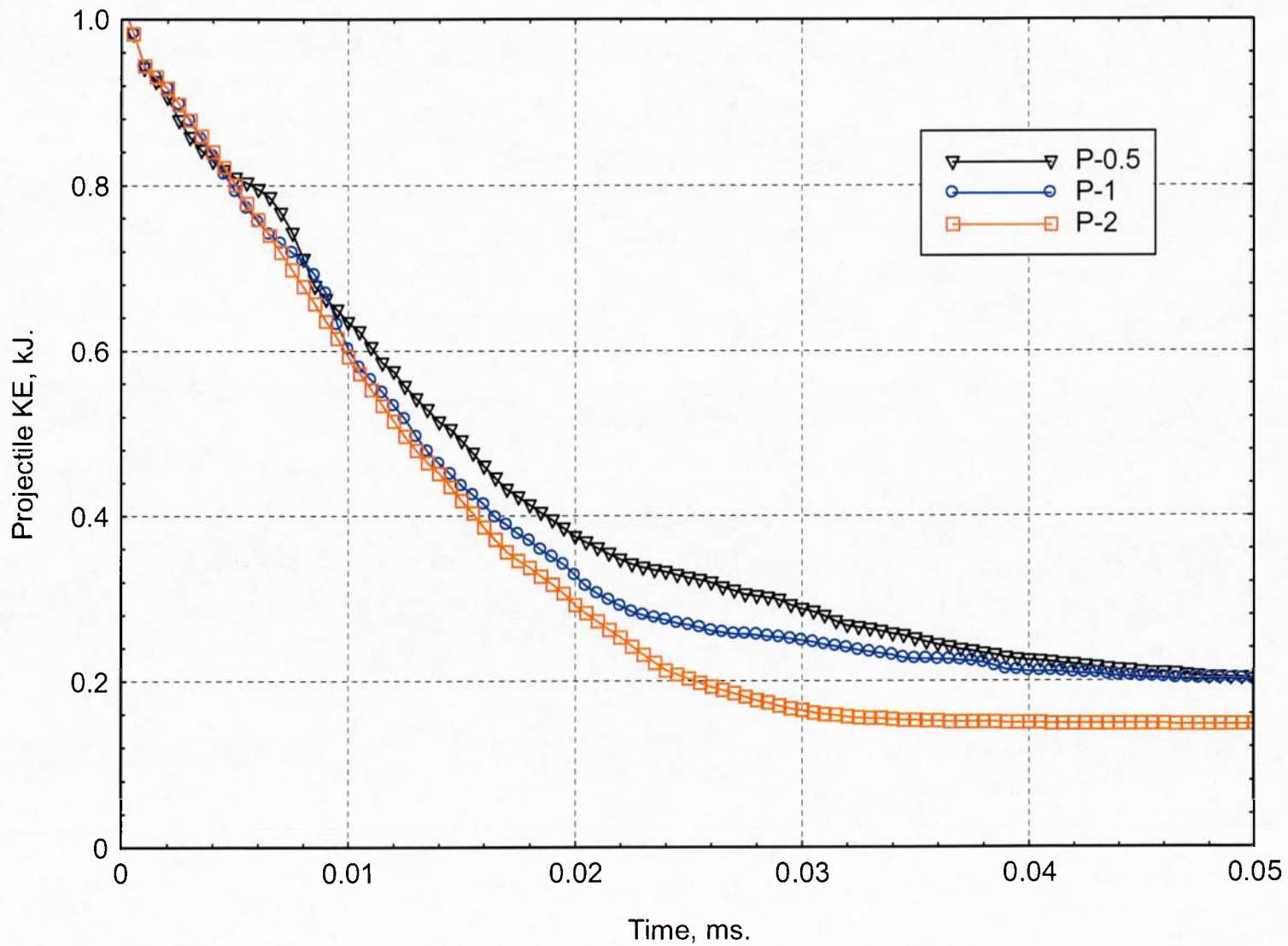
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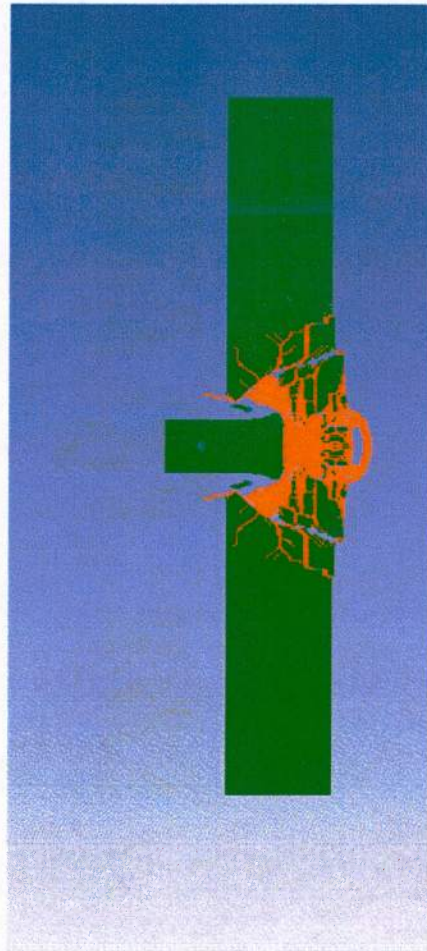
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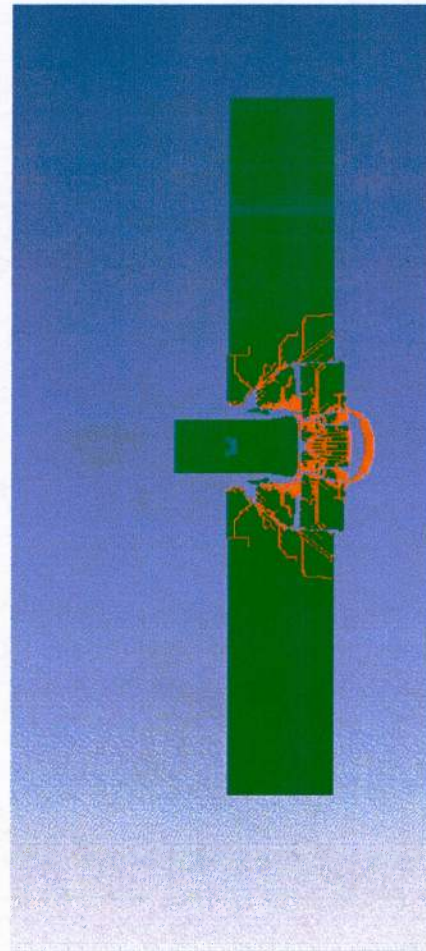
Energy Profile: T-2



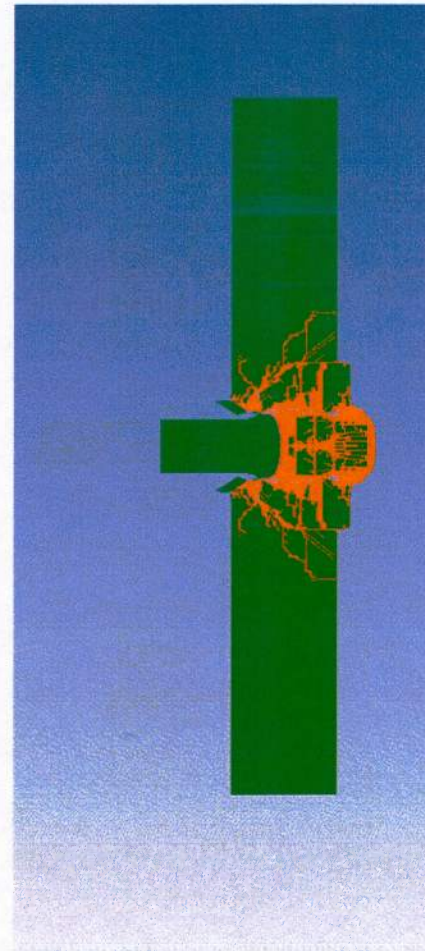
Fracture Pattern GS vs. PS



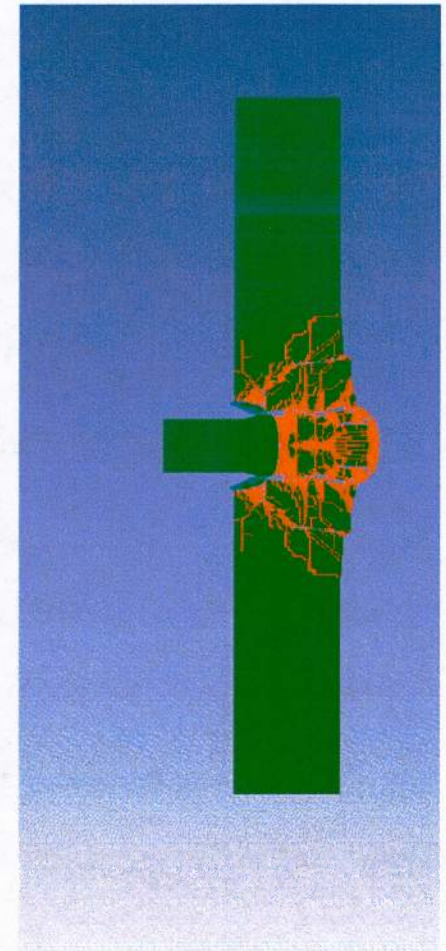
GS-P-1-T-1



PS-P-1-T-1



GS-P-2-T-2



PS-P-2-T-2

Profile: 797480 Reservation: 6992930 - Electronic Reservation Confirmation -- Transaction ID: 63126145

SSAInfoDoNotReply@steamshipauthority.com

Sent: Tuesday, April 09, 2013 2:00 AM

To: Wool, Richard P

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Please review the following information for accuracy.

You may view or change this information online at <http://www.steamshipauthority.com>, click on View/Change/Cancel Existing Reservations. You may also call our Reservation Office at (508) 477-8600 during normal business hours.

Reservation Number: 6992930 Name: RICHARD & DEB WOOL

Phone Numbers:

Home: 302-369-9488 Island:

Work: 302-831-3312 Cell:

Vehicle Information:

Year: 2003 Make: JAGU Model: XJ8 : 4-DR. SEDAN

State: DE Plate: RICH1 Type: CAR/TRL<15FT

Reservation Information

Trip Day	Date	Time	From	To	Vehicle	Adult	Child
203 Sunday	07/28/2013	07:30A	Woods Hole	Vineyard Haven	CAR/TRL<15FT	1	0
032 Sunday	08/11/2013	09:30P	Vineyard Haven	Woods Hole	CAR/TRL<15FT	1	0

Pricing & Payment Information

Departure Pricing: 140.50

Return Pricing: 140.50

Paid By: Visa Ending with 9306 Amount: 281.00

ISSUED SUBJECT TO TERMS AND CONDITIONS OF THE APPLICABLE TARIFF REGULATIONS ON FILE AND SUBJECT TO THE ACCEPTANCE BY THE PURCHASER OF THE FOLLOWING CONDITIONS:

1. VEHICLES LESS THAN 20 FEET MUST BE CANCELED AT LEAST FOURTEEN (14) DAYS IN ADVANCE OF SCHEDULED DEPARTURE TIME TO RECEIVE A REFUND. VEHICLES OVER 20 FEET MUST BE CANCELED AT LEAST 24 HOURS BEFORE SCHEDULED

DEPARTURE TO RECEIVE A REFUND.

2. THERE IS A \$10.00 PROCESSING CHARGE FOR ALL REFUNDS REGARDLESS OF WHEN CANCELLATION NOTICE IS RECEIVED.

3. RESERVATIONS MAY BE CHANGED UP TO ONE HOUR BEFORE THE SCHEDULED DEPARTURE. ONE DATE CHANGE MAY BE MADE TO A VEHICLE RESERVATION AT NO CHARGE. HOWEVER, IF THE CHANGE IS MADE LESS THAN FOURTEEN (14) DAYS IN ADVANCE OF SCHEDULED DEPARTURE, THE CHANGED RESERVATION WILL NOT BE ELIGIBLE FOR A REFUND IF SUBSEQUENTLY CANCELED. YOU HAVE ONE DATE CHANGE AT NO CHARGE, ALL OTHER CHANGES MAY BE MADE ONLY UPON PAYMENT OF AN ADDITIONAL NON-REFUNDABLE \$10.00 CHARGE.

4. RESERVATIONS ARE VALID FOR ONE YEAR FROM THE DATE THEY WERE ORIGINALLY ISSUED, SUBJECT TO ALL REFUND AND CANCELLATION POLICIES AFOREMENTIONED.

Profile: 797480 Reservation: 6992939 - Electronic Reservation Confirmation -- Transaction ID: 63126146

SSAInfoDoNotReply@steamshipauthority.com

Sent: Tuesday, April 09, 2013 2:00 AM

To: Wool, Richard P

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If you use our Wait List, we recommend that you confirm your current reservation information. In the event we're unable to reach you to confirm your changes, it is always prudent to check your confirmation on our website or to call our Reservation Office 48 hours ahead of your requested travel date to confirm your final reservation.

Please review the following information for accuracy.

You may view or change this information online at <http://www.steamshipauthority.com>, click on View/Change/Cancel Existing Reservations. You may also call our Reservation Office at (508) 477-8600 during normal business hours.

Reservation Number: 6992939 Name: RICHARD & DEB WOOL

Phone Numbers:

Home: 302-369-9488 Island:

Work: 302-831-3312 Cell:

Vehicle Information:

Year: 2012 Make: TOYO Model: CAMRY : 4-DR. SEDAN

State: DE Plate: DEB1 Type: CAR < 17FT

Reservation Information

Trip Day	Date	Time	From	To	Vehicle	Adult	Child
203 Sunday	07/28/2013	07:30A	Woods Hole	Vineyard Haven	CAR < 17FT	1	0
032 Sunday	08/11/2013	09:30P	Vineyard Haven	Woods Hole	CAR < 17FT	1	0

Pricing & Payment Information

Departure Pricing: 76.50

Return Pricing: 76.50

Paid By: Visa Ending with 9306 Amount: 153.00

ISSUED SUBJECT TO TERMS AND CONDITIONS OF THE APPLICABLE TARIFF
REGULATIONS ON FILE AND SUBJECT TO THE ACCEPTANCE BY THE PURCHASER OF
THE FOLLOWING CONDITIONS:

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IN ADVANCE OF SCHEDULED DEPARTURE TIME TO RECEIVE A REFUND. VEHICLES
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2. THERE IS A \$10.00 PROCESSING CHARGE FOR ALL REFUNDS REGARDLESS OF WHEN CANCELLATION NOTICE IS RECEIVED.

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